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Abstract

All Christians have been commanded by Jesus Christ to share the Gospel message with unbelievers so that they too may be saved. However, few Christians regularly share the Gospel with non-Christians, and there are eternal consequences to this disobedience for everyone. A Markov chain model is proposed for estimating over time the proportions of persons who are saved and receive eternal life in heaven and who are condemned to hell. An evaluation and an analysis of the model are presented. Simulation results for the model indicate that a moderate increase in present personal evangelism efforts will result in only modestly more salvations over time. Therefore, substantially more intense evangelism efforts must be undertaken and sustained to make a significant difference in the number of souls that are ultimately saved. Sadly, some persons will choose never to be saved, regardless of how many and how often Christians share the Gospel. Finally, a more extensive Markov chain model based on the five faith stages of the unchurched suggested by Rainer (2003) is discussed and demonstrated.

> "You will receive power when the Holy Spirit has come upon you; and you shall be My witnesses both in Jerusalem, and in all Judea and Samaria, and even to the remotest part of the earth." - *from Acts 1:8 (NASB)*

Introduction

Jesus Christ said that He came to earth to save sinners from

the judgment they deserve (Luke 19:10). With His final words to His followers, He delegated the responsibility of proclaiming the Gospel, the good news of forgiveness and salvation, to His disciples (Acts 1:8). Unfortunately, it has been estimated that only between 3 and 5 percent of all Christians, Jesus' modern day disciples, share their faith, or the Gospel message, with non-Christians.[4] This widespread disobedience leaves far too few opportunities for non-Christians to learn of God's loving and gracious plan to provide salvation for all of humankind.

The Holy Bible, the divinely inspired (2 Timothy 3:16) and inerrant (Psalm 119:160) word of God, has been provided by God so that its readers and hearers might come to a saving knowledge of Jesus Christ (John 20:31, 1 John 5:13). From the first books of the Old Testament, it is clear that God's intention has always been for His people to proclaim to others His majesty and His mercy, as well as His greatness and His grace.[5]

According to the Bible, all persons are sinners (Romans 3:23) whose intimate relationship with God has been destroyed due to their sins (Isaiah 59:2). Since God is perfect (Matthew 5:48) and cannot be in the presence of sin, no person may be admitted into heaven with even one unforgiven sin (Revelation 21:27). Because God loves the people He has created in His own image (Genesis 1:27) so much, He graciously provided the ideal solution to humanity's problem with sin. God sent His only Son, Jesus Christ, to earth as a man to live a sinless life (2 Corinthians 5:21) and to die on a cross in order to pay the steep price (Romans 6:23a) for humanity's sins, a price that people could never pay on their own. God sent Jesus to die in the place of sinful humans because of how much He loves them (Romans 5:8). As prophesied (Psalm 16:10), God raised Jesus from the dead on the third day (1 Corinthians 15:4). He did so because He was satisfied with Jesus' payment for humanity's sins (Romans 4:25).

Now anyone who repents of his or her sins and accepts Jesus Christ as personal Lord and Savior will be saved (Romans 10:9), that is, he or she will receive eternal life and heaven. Besides trusting Jesus completely, there is no other way for a person to be saved (John 14:6, Acts 4:12), especially on the basis of his or her own merit (Ephesians 2:8-9, Titus 3:5). Anyone who does not repent and surrender to the Lordship of Jesus Christ will be condemned to hell (Luke 13:3, 5) due to their own unbelief (John 3:18). There are no exceptions with God (Romans 2:11).

But God does not want anyone to perish in hell (2 Peter 3:9). That is why Jesus came and why He commissioned His followers (Matthew 28:18-20) to tell others about Him and about God's free gift of salvation (Romans 6:23b). God offers His salvation to

everyone (John 3:16), and each person has the right to choose to accept or to reject God's offer (Matthew 10:14). Everyone who surrenders to the Lord will be saved (Joel 2:32, Acts 2:21, Romans 10:13) and once saved or born again (John 3:3), a person's eternal destiny is forever secure (John 10:27-30).

The message about Jesus and His sacrifice of Himself for sinful humanity must be shared with urgency by faithful Christians if unrepentant persons so dearly loved by God are to be saved (Romans 10:14). It is not enough that the Gospel is proclaimed in church services, and even on television, if the persons who most need to hear this message do not hear it. Personal evangelism, the one-on-one communication of the Gospel message by Christians to non-Christians, is a major factor in reaching persons for Christ.[6] Since church attendance is declining in the U.S.[7], particularly among younger people who are those most likely to be receptive to the Gospel[8], the importance of personal evangelism has never been greater than it is now.

This paper considers the questions of how important personal evangelism, or witnessing to unbelievers, is and what impact witnessing by Christians will ultimately have on the proportions of persons who are saved and who are eternally condemned. A simple mathematical model of the spiritual decision process is suggested. Following analysis and evaluation of the model, numerical simulations are executed under varying hypothetical assumptions to project over time the eternal destinies of the people God has created. The implications of the simulation results for Christians and non-Christians are discussed. A second, larger model based on Rainer's faith stages[9] of the unchurched is introduced and demonstrated.

Basic Markov Chain Model

A simple discrete-time, discrete state Markov chain model is proposed for the spiritual decision process. Markov chain models are used to represent a system or process whose state or condition changes over time. At any discrete point in time, the system or process is completely characterized by the state of the system.[10] Common example applications of Markov chain models include market-share analyses for competing products (where the states might represent the most recent purchase among competing products) and career or academic progression (where the states might represent a current job title or class in school).

The present model is loosely based on the complete spiritual decision process model which has come to be referred to as the Engel scale.[11] Variants of the Engel scale have been suggested by

others.[12, 13, 14] Although the basic model suggested here has a unique mathematical formulation, it is conceptually simpler than the Engel scale and the variants thereof.

The basic Markov chain model proposed here has four states, two transient states and two absorbing states. The transient states represent the two possible spiritual conditions of living persons: they are either lost, State L, (Matthew 18:11) or regenerated, State RG, (that is, born again (John 3:3)). The absorbing states represent the two possible eternal conditions of persons whose earthly life has ended: they are either condemned to hell, State CH, or admitted to heaven, State HV (Matthew 25:46).

Because of original sin (Romans 5:12), all accountable persons are initially in State L. During their lives, they may choose to accept God's offer of salvation and be reborn as an adopted child of God (Galatians 4:6-7). In other words, each person may transition from State L to State RG during his or her earthly life. According to Geisler, the preponderance of the Biblical evidence suggests that a transition from RG to L cannot happen.[15] The author agrees with Geisler, and consequently it is assumed that no such transitions are possible in the model presented here.

At some point, whether in State L or State RG, each person will die. After death, each person is judged by God (Hebrews 9:27). Persons in State L at the time of their death transition to State CH, and persons in State RG transition to State HV. Once either of these absorbing states is entered, no further state changes are possible (Luke 16:26).

The basic model considers a person's spiritual condition at specified points in time, for example, once per month. Alternative time periods might be used; one could even use encounters with the Gospel message as the mechanism for advancing simulated "time" in the model (as is demonstrated in a later section of this paper).

Let p_{ij} be the probability that a person transitions from State i to State j in one time period, where i and j each represent L, RG, CH, or HV. The one-step transition probability matrix for this Markov chain is of the following form:

$$\mathbf{P} = \begin{pmatrix} \mathbf{Q} & \mathbf{R} \\ \mathbf{0} & \mathbf{I} \end{pmatrix} = \begin{pmatrix} 1 - p_{L,RG} - p_{L,CH} & p_{L,RG} & p_{L,CH} & 0 \\ 0 & 1 - p_{RG,HV} & 0 & p_{RG,HV} \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix}$$

The probabilities in the sub-matrix $\mathbf{Q}$ are for transitions among the transient states (L and RG), and the probabilities in the sub-matrix $\mathbf{R}$ are for transitions from transient states to absorbing states (CH and HV). Once an absorbing state is reached, all subsequest "transitions" are returns to the same absorbing state. Therefore, the identity sub-matrix, $\mathbf{I}$, governs transitions among the absorbing states. Transitions out of either absorbing state are impossible, so the zero sub-matrix, $\mathbf{0}$, represents these impossible transitions.

To characterize an instance of this Markov chain, the off-diagonal transition probabilities in the first two rows, $p_{L,RG}$, $p_{L,CH}$, and $p_{RG,HV}$, must be specified. Then, the probabilities along the diagonal in those rows are calculated so that the sum of the probabilities across each row is 1.

In order to determine the probabilities of condemnation and eternal life after a finite time, one can calculate multi-step transition probability matrices by raising the one-step transition probability matrix to an appropriate power. For instance, the three-step transition probabilities are given by the matrix $\mathbf{P}^{(3)} = \mathbf{PPP}$.[16] The probability $p_{L,RG}^{(3)}$ indicates how likely it would be for a person to start the process in State L and to be in State RG after three time periods. In such a case, nothing would be known about the person's state after one and two time periods, except that the person was did not reach either State CH or State HV. (If the person had entered either of the absorbing States CH or HV, he or she would still and forever be in whichever state had been entered.) It would not be known when the transition from State L to State RG took place, only that it took place some time during the first three time periods. A multi-step transition probability matrix, $\mathbf{P}^{(k)}$ can be computed for any finite integer k.

Example 1. Consider the following transition probability matrix for a Markov chain with two transient states (States 1 and 2) and one absorbing state (State 3):

$$\mathbf{P} = \begin{pmatrix} 0.4 & 0.1 & 0.5 \\ 0.2 & 0.6 & 0.2 \\ 0 & 0 & 1 \end{pmatrix}.$$

The four-step transition matrix in this case is:

$$\mathbf{P}^{(4)} = \mathbf{PPPP} = \begin{pmatrix} 0.0524 & 0.0560 & 0.8916 \\ 0.1120 & 0.1644 & 0.7236 \\ 0 & 0 & 1 \end{pmatrix}.$$

The probability of being in State 3 after four transitions, given that the initial state was State 1, is $p_{13}^{(4)} = 0.8916$.

Evaluation of the Markov Chain Model

No mathematical model, including the Markov chain model introduced here, is a perfect representation of whatever system or process it is intended to stand for. Before the model is analyzed in detail, a brief, but frank, evaluation of the model is given.

It is certainly presumptuous to think that a person's response to the supernatural work of the Holy Spirit in the spiritual decision process (John 16:8-11) may be represented with a simple mathematical model. However, there does appear to be an element of randomness or chance in the process of conversion of unbelievers. Some persons who are confronted with the truth of the Gospel repent of their sins and immediately put their trust in Jesus Christ as Lord and Savior (Mark 1:18). Others become increasingly receptive to the Gospel with each hearing of the message and eventually surrender their lives to Christ. Finally, there are some persons who are repeatedly presented the Gospel message and regrettably never come to repentance and faith.

There are two important assumptions that are implicit in all Markov chain models. One of these assumptions is the Markov assumption, which says that the probability of transitioning to the next state depends only on the current state.[17] In other words, any states that may have been visited previously have no bearing on the transition to the next state. If one thinks that a person's entire spiritual history (or any other factor), and not just his or her current spiritual state, would affect the transition to a new state, then perhaps a Markov chain is not the best model to use.

A second assumption implicit in a Markov chain model is the stationarity assumption.[18] This assumption means that, for every pair of states, the probability of transitioning between those states does not change over time. In other words, a person is just as likely to transition from one particular state to another particular state in the next time period as that person is likely to

transition between those states t time periods later, regardless of the value of t. There is evidence that the probability of a person transitioning from State L to State RG decreases over time as the person ages.[19] So the model's estimates for the proportion of persons who are ultimately admitted to heaven may be optimistic. Additionally, world events, such as the terrorist attacks of September 11, 2001, appear to affect a person's receptivity to the Gospel for a short time.[20] So there is reason to believe that the transition probabilities in the Markov chain model of the spiritual decision process are not absolutely stationary.

Nevertheless, this Markov chain model may be used judiciously to represent the spiritual decision process for one person or for many persons and to project the relative impact of changes in evangelistic intensity on the final states of a fixed set of people. It will not, however, accurately predict the final census of either heaven or hell. After k simulated time periods, the probabilities in the first row of $\mathbf{P}^{(k)}$ indicate how likely it is that a person of interest is in any of the four states at that time. If we assume that all persons make their spiritual decisions independently of the decisions of others and their spiritual decision processes are represented by the same one-step transition probability matrix, then the k-step transition matrix may be used to estimate the proportions of all persons of interest in each of the four states after k time periods.

Finally, gender, ethnicity, education level, and income are some factors that may influence a person's openness to the Gospel message.[21] More precise estimates of the proportions of people who are ultimately saved and condemned might be obtained if separate Markov chain models were developed for different combinations of demographic factors.

Analysis of the Basic Markov Chain Model

A standard analysis of a Markov chain with absorbing states, as outlined by Higgins and Keller-McNulty[22] and Winston[23], yields the following results.

First of all, the fundamental matrix for the Markov chain introduced in §2 is:

$$\mathbf{U} = (\mathbf{I} - \mathbf{Q})^{-1} = \begin{pmatrix} \dfrac{p_{RG,HV}}{(p_{L,RG} + p_{L,CH})p_{RG,HV}} & \dfrac{p_{L,RG}}{(p_{L,RG} + p_{L,CH})p_{RG,HV}} \\ 0 & \dfrac{p_{L,RG} + p_{L,CH}}{(p_{L,RG} + p_{L,CH})p_{RG,HV}} \end{pmatrix}.$$

Every person begins his or her life as an accountable person in State L. The entries in the first row of $\mathbf{U}$ indicate how many time periods a person who is initially in State L is expected to be in each of the transient States L and RG, respectively, before absorption in either State CH or State HV. So the sum of the two entries in the first row is an estimate of a typical person's life span after reaching the age of accountability. (The entries in the second row of $\mathbf{U}$ indicate how many time periods a person who is initially in State RG would be expected to be in each of the transient States L and RG. However, no accountable person is initially in State RG (Psalm 51:5). These entries are shown for completeness only.)

The final (absorbing) state depends on whether the person is in State L or in State RG at the time of his or her death. The absorption probability distribution for the absorbing States CH and HV is given in the first row of the matrix $\mathbf{F} = \mathbf{UR}$:

$$\mathbf{F} = \mathbf{UR} = \begin{pmatrix} f_{L,CH} & f_{L,HV} \\ f_{RG,CH} & f_{RG,HV} \end{pmatrix}$$

$$= \begin{pmatrix} \dfrac{p_{RG,HV}\,p_{L,CH}}{p_{RG,HV}\,p_{L,CH} + p_{L,RG}\,p_{RG,HV}} & \dfrac{p_{L,RG}\,p_{RG,HV}}{p_{RG,HV}\,p_{L,CH} + p_{L,RG}\,p_{RG,HV}} \\ 0 & 1 \end{pmatrix}.$$

(The second row of $\mathbf{F}$ gives absorption probabilities for persons who are initially in State RG. Since there are no such persons, this row is shown for completeness only.)

The absorption probabilities in the first row of $\mathbf{F}$ indicate how likely it is that a person who has reached the age of accountability would reach State CH or State HV after an infinite number of time periods. Since every person's lifetime is finite,

the distribution of the final state shown above is optimistic. It also shows that some persons would not be converted even if they had an infinite time to come to repentance and faith, unless $p_{L,CH} = 0$ or $p_{RG,HV} = 0$, neither of which is possible given the certainty of death.

Example 2. As a purely hypothetical example, let $p_{L,RG} = 0.005$, $p_{L,CH} = 0.003$, and $p_{RG,HV} = 0.001$. Then it follows that:

$$\mathbf{P} = \begin{pmatrix} 0.992 & 0.005 & 0.003 & 0 \\ 0 & 0.999 & 0 & 0.001 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix}, \mathbf{U} = \begin{pmatrix} 125 & 625 \\ 0 & 1000 \end{pmatrix}, \text{and } \mathbf{F} = \begin{pmatrix} 0.375 & 0.625 \\ 0 & 1 \end{pmatrix}.$$

Under the assumptions made in this example, a person would have an average of 125 time periods in State L and an average of 625 time periods in State RG before being absorbed in either State CH or State HV. Three out of every eight persons would ultimately be absorbed in State CH, while five of eight would ultimately be absorbed in State HV.

How many time periods, on average, does it take for a person in State L to be converted, that is, to reach State RG? If the state transition in each time period is independent of the transitions in all other time periods (and if persons in State L do not die), the number of time periods until conversion is a geometric random variable with mean $1/p_{L,RG}$ and variance $(1-p_{L,RG})/(p_{L,RG})^2$. For example, if $p_{L,RG} = 640^{-1}$, then the expected number of time periods until conversion is 640. (Note that all persons who are never converted are included in this average.) The variance of the number of time periods until conversion is 408,960. The coefficient of variation is $\sqrt{1-p_{L,RG}}$, which is relatively large (specifically, approximately 1) when $p_{L,RG}$ is small. This suggests that there is much variability in the length of time it takes for a person to respond favorably to the Gospel message, so that persistence and perseverance in personal evangelism are important for Christians. Fortunately, God is patient (2 Peter 3:9).

Following the analysis above, an important question to ask is: What impact will personal evangelism have on the proportion of persons who are ultimately in State HV? Alternatively, the proportion of persons who are ultimately in State CH may be

considered, as will be done here. It is clear, since $p_{L,RG}$ appears only in the denominator of $f_{L,CH}$, that fewer persons will ultimately be absorbed in State CH if $p_{L,RG}$ increases (and all other model parameters are unchanged).

One can define the limiting (or infinite time) hell-to-heaven odds ratio as follows:

$$\lim_{n\to\infty} \frac{p_{L,CH}^{(n)}}{p_{L,HV}^{(n)}} = \frac{f_{L,CH}}{f_{L,HV}} = \frac{p_{L,CH}}{p_{L,RG}}.$$

So it is more likely that a person will ultimately be in State HV than he or she will be in State CH if and only if $p_{L,CH} < p_{L,RG}$ (as is the case in Example 2). This necessary and sufficient condition means that it is more likely in any time period that a person in State L would repent and be converted than he or she would die. If, on the other hand, $p_{L,CH} \geq p_{L,RG}$, then it would be at least as likely that a person would ultimately reach State CH as it would be for him or her to ultimately reach State HV.

With the passage of time, the spiritual conditions of the persons represented in the model become increasingly finalized. Some are born again with the attendant eternal security God promises (John 5:24); others die, either having been saved or having no further opportunity to be saved. Therefore, the probability $p_{L,L}^{(k)}$ is an indirect measure of the finality of the spiritual conditions of the persons of interest after k time periods. The potential harvest of persons of interest that might be reaped from new or expanded evangelism efforts is directly related to the spiritual condition finality at the time those efforts are implemented.

Simulation of the Markov Chain Model

An Excel spreadsheet was developed to facilitate the simulation of the Markov chain model for up to 1200 months, or 100 years. The simulation, therefore, goes well beyond the normal remaining life span of a person who reaches the age of accountability where he or she can distinguish between right and wrong, good and evil, and make a conscious and willful decision about a faith relationship with God through His Son, Jesus Christ.

One should keep in mind that all of the numerical assumptions and the simulation results reported in this paper are completely hypothetical. They should not be interpreted as accurate projections of the proportions of persons who will be condemned to hell and who will be admitted to heaven. However, the model is still quite useful to demonstrate the relative impact of personal evangelism over time and how the intensity of evangelistic efforts will affect the distribution of the final states of humanity.

Base-Case Simulations

Two instances of the basic Markov chain model are simulated. In the first instance (Example 3), $p_{L,RG} < p_{L,CH}$, so that more persons are ultimately expected to reach State CH than will reach State HV. In the second instance (Example 4), $p_{L,RG} > p_{L,CH}$ instead.

Example 3. It is assumed that $p_{L,CH} = p_{RG,HV} = 800^{-1}$ and $p_{L,RG} = 2000^{-1}$. Table 1 reports the probability of final condemnation to hell ($p_{L,CH}^{(k)}$), the probability of admission to heaven ($p_{L,HV}^{(k)}$), the hell-to-heaven odds ratio ($p_{L,CH}^{(k)} / p_{L,HV}^{(k)}$), and the spiritual condition finality measure ($p_{L,L}^{(k)}$) for selected numbers of time periods (months), k. Note that $p_{L,CH}^{(k)} / p_{L,HV}^{(k)}$ is said to be undefined if $p_{L,HV}^{(k)} = 0$.

The limiting hell-to-heaven odds ratio is 2.50, as 5 out of every 7 persons would ultimately reach State CH. The early hell-to-heaven odds ratios are frighteningly high. The ratios do improve over time as more people have opportunities to respond to the Gospel message. Note, however, that the hell-to-heaven odds ratio after 1200 months is more than 60% greater than it is after an infinite number of months. No matter how optimistic the analysis seems to be in the limiting case, the practical reality is that a much greater proportion of people would reach State CH than the limiting case suggests (Luke 13:24).

The spiritual condition finality measure, $p_{L,L}^{(k)}$, suggests that there would potentially be a much greater harvest of souls if personal evangelism efforts were more intense from the outset. Under the assumptions of this example, over 90 percent of the

persons of interest would remain in State L after 60 months. Although the finality measure seems to improve over time, it simply deceases because, as time passes, there are fewer and fewer persons of interest who still might be reached with the Gospel.

Example 4. The spreadsheet simulation was run again under the assumptions that $p_{L,CH} = p_{RG,HV} = 800^{-1}$ and $p_{L,RG} = 780^{-1}$. The simulation results in Table 2 appear somewhat rosier than those in Table 1. For this example, more people ultimately reach State HV than reach State CH since $p_{L,RG} > p_{L,CH}$. However, the hell-to-heaven odds ratio would not drop below 1 until well after 1200 months have passed. Even if $p_{L,RG} > p_{L,CH}$, there is great potential benefit to more intense personal evangelism efforts as the values of $p_{L,L}^{(k)}$ indicate.

Simulation of More Intense Evangelism Efforts

Unfortunately, regardless of the intensity of evangelism efforts, there will be some people who reject God's free gift of eternal life and who ultimately reach State CH because they choose not to believe. A question to consider though is: What difference would more intense evangelism efforts make on the final states of people?

It seems reasonable to assume that greater intensity in personal evangelism will lead to more opportunities for lost persons to hear the proclamation of the Gospel. With more opportunities to choose whether a person wants to place his or her trust in Christ as Lord and Savior, there would be a consequent greater probability of the person being saved in any time period. In other words, $p_{L,RG}$ would be increased if ongoing personal evangelism efforts were more intense.

Consider a modification of the basic Markov chain model. Specifically let

$$\mathbf{P}' = \begin{pmatrix} 1 - p_{L,RG}(1+\alpha) - p_{L,CH} & p_{L,RG}(1+\alpha) & p_{L,CH} & 0 \\ 0 & 1 - p_{RG,HV} & 0 & p_{RG,HV} \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix}$$

where $\alpha \geq 0$ is a measure of increased evangelism intensity.

Note that $\alpha = 0$ corresponds to a "business as usual" scenario when it comes to personal evangelism.

Example 5. Recall Example 3. The spreadsheet simulations were executed with state transitions governed by the matrix $\mathbf{P}'$ for $\alpha = 0.01$, 0.05, 0.25, and 0.50. These assumed values of the parameter α represent moderate absolute changes in personal evangelism intensity. For instance, when $\alpha = 0.50$, at most only 7.5 percent of Christians would be sharing the Gospel message (if up to 5 percent do so already[24]). The simulation results for this example are summarized in Tables 3 and 4.

Table 3 reports the *k*-month probability of condemnation to hell ($p_{L,CH}^{(k)}$) for several values of α after various numbers of months. These results show that intensifying personal evangelism efforts will reduce the proportion of persons who reach State CH, at least beyond the short term. However, the estimated impacts of moderately more intense personal evangelism efforts on the proportions of persons who reach State CH are rather modest.

Table 4 shows that spiritual condition finality measures ($p_{L,L}^{(k)}$) corresponding to each combination of k and α in Table 3. Once again, it is obvious that there is great potential to reach more lost people for Christ than would be reached under present or even moderately more intense personal evangelism efforts.

Example 6. Recall Example 5. The spreadsheet simulations were executed again for $\alpha = 1$, 3, 5, 9, and 19. These assumed values of α represent more aggressive increases in personal evangelism efforts. Note that $\alpha = 1$ represents a doubling of the usual evangelism intensity, and $\alpha = 19$ would potentially mean that all Christians are sharing the Gospel message (provided 5 percent of Christians normally share their faith already). The simulation results for this example are summarized in Tables 5 ($p_{L,CH}^{(k)}$) and 6 ($p_{L,L}^{(k)}$).

Table 5 shows that substantially more intense personal evangelism effort leads to significant reductions in the proportions of persons who ultimately reach State CH. It is interesting to note from both Tables 3 and 5 that the effect of greater evangelistic intensity is not immediately evident. It takes time for there to be a noticeable decrease in $p_{L,CH}^{(k)}$, just as it takes time for compound interest to accrue and impact an account balance. Not only is there a need for more intense evangelism efforts, but

there is also a need to sustain those more intense efforts. Over an extended time, aggressively more intense personal evangelism efforts would be quite fruitful, as is evident from a comparison of Tables 5 and 6 with Tables 3 and 4. However, even with the maximum intensity of personal evangelism simulated here, there would be people who reach State CH due to their unbelief.

Model Based on the Rainer Scale

Extensions of the Markov chain model may be developed. For example, the two transient states in the basic model could be replaced by six (or more) transient states. One possibility is to replace State L with five states that correspond to the faith stages of unchurched persons on the Rainer scale[25] (see Figure 1 below). Other possibilities include using the Engel scale[26] or any of the other variants of the Engel scale that have been suggested.[27, 28]

State	Description of state	Type of state
U5	Highly antagonistic to the Gospel/church	Transient
U4	Resistant to the Gospel/church	Transient
U3	Neutral to the Gospel/church	Transient
U2	Receptive to the Gospel/church	Transient
U1	Very receptive to the Gospel/church	Transient
RG	Regenerated/converted	Transient
CH	Condemned to hell	Absorbing (upon death)
HV	Admitted to heaven	Absorbing (upon death)

Figure 1. State Descriptions and Types for Markov Chain Model Based on the Rainer Scale

A significant challenge with any larger model is the problem of estimating a greater number of transition probabilities. The overall conclusions from simulation would not be expected to change, and there are some potential advantages to models with more transient states. For instance, as the distribution of the states of lost people (say, U5, U4, U3, U2, and U1) may noticeably change over time, new evangelism strategies might be formulated to more effectively reach lost persons in their current spiritual condition with the Gospel message. With even more transient states for regenerated persons (as there are in the Engel scale), the spiritual growth of believers can be modeled. New discipleship strategies might be formulated as well to support the maturation of Christians whose mix of spiritual conditions changes over time.

The spiritual condition finality measure is modified for this larger model. For each of the states representing a faith stage i (i = U5, U4, U3, U2, U1) of unchurched persons, the measure of spiritual condition finality after ℓ Gospel encounters for persons

who were originally in State i is given by:

$$p_i^{(\ell)} = \sum_{j=U5}^{U1} p_{ij}^{(\ell)} = 1 - p_{i,RG}^{(\ell)} - p_{i,CH}^{(\ell)} - p_{i,HV}^{(\ell)}.$$

Example 7. Consider a Markov chain model of the spiritual decision process based on Rainer's faith stages for the unchurched. A purely hypothetical one-step transition matrix is shown in Figure 2. For this example, the time between transitions is measured in encounters with the Gospel message (including personal witnessing by Christians, church services, revivals, testimonies on Christian radio stations, televised messages by evangelists, etc.) rather than in conventional units of time. Note that spiritual progress is limited here to two faith stages per transition; Saul's conversion (Acts 9) suggests that an immediate transition from State U5 to State RG is possible, but probably rare.

		U5	U4	U3	U2	U1	RG	CH	HV
	U5	0.949	0.0008	0.0002	0	0	0	0.05	0
	U4	0.0015	0.9765	0.0015	0.0005	0	0	0.02	0
	U3	0.0005	0.0025	0.984	0.0025	0.0005	0	0.01	0
P =	U2	0	0.005	0.025	0.937	0.025	0.005	0.003	0
	U1	0	0	0.001	0.002	0.746	0.25	0.001	0
	RG	0	0	0	0	0	0.999	0	0.001
	CH	0	0	0	0	0	0	1	0
	HV	0	0	0	0	0	0	0	1

Figure 2. One-Step Transition Matrix for Markov Chain Model Based on Rainer's Faith Stages

Rainer estimates that there are 160 million unchurched persons in the U.S. distributed across the five faith stages as follows: 5% (U5), 21% (U4), 36% (U3), 27% (U2), and 11% (U1).[29] Furthermore, it is assumed here that "unchurched" is synonymous with "lost" in the earlier Markov chain model. An Excel spreadsheet simulation was executed so that the spiritual conditions of these unchurched persons could be projected over time.

Table 7 shows the changing distribution of the spiritual conditions of the unchurched as they have more and more encounters with the Gospel message. It could take a considerably longer time for a person in State U5 to hear the Gospel three times than it would for, say, a person in State U2. So each row in Table 5 should not be thought of as a future snapshot of the spiritual condition distribution of the presently unchurched. It may take years for a U5 to experience five encounters with the Gospel message, while a U1 could do so in a month or less.

Table 8 presents the hell-to-heaven odds ratios after various numbers of Gospel encounters for unchurched persons originally classified in each of the States U5 through U1. There is a very bleak prospect for a U5 to reach State HV, even if he or she were to have numerous Gospel encounters. All unchurched persons are important to God, and none should be disregarded. However, the urgency for personal evangelism efforts intended to reach U5s is unmistakable. After four Gospel encounters, a U5 is more than 6 billion times as likely to reach State CH as he or she is likely to reach State HV. It will likely be rare that U5s even find themselves in a position to encounter the Gospel message many times since they rarely attend church[30], and even if they do, it is very unlikely that the message will have a positive spiritual impact on them.

The prospect for a U1 is profoundly better. For example, after just eight Gospel encounters, a U1 is more likely to ultimately reach State HV than to reach State CH (since $p_{L,CH}^{(8)} / p_{L,HV}^{(8)} < 1$). As expected, U2s would fare better than U3s, who would fare better than U4s.

Table 9 shows the spiritual condition finality measures for unchurched persons originally classified in each faith stage after various numbers of Gospel encounters. Although the entries in the columns for U5s and U1s may appear similar, they tell very different stories. The values of $p_{U5}^{(\ell)}$ drop quickly as ℓ increases because Gospel encounters for U5s tend to be few and far between. The changes in $p_{U5}^{(\ell)}$ are not primarily due to conversions, but rather to deaths and transitions from State L to State CH. The values of $p_{U1}^{(\ell)}$, on the other hand, also drop quickly as persons who are "very receptive" to the Gospel likely repent and come to faith in Christ.

Discussion

The Markov chain model of the spiritual decision process introduced here facilitates the quantification of the impact of personal evangelism on the proportions of persons who are admitted to heaven and who are condemned to hell. The model is imperfect and likely presents an optimistic picture of the final states of human beings. Nevertheless, it is useful for evaluating the potential impact of more intense personal evangelism efforts. One should be cautious about any in-depth analysis of the simulation results as these results are very much dependent on the assumed transition probability values and the implicit Markov

and stationarity assumptions.

Note that the limiting hell-to-heaven odds ratio for U2s (0.928) shown in Table 8 indicates that U2s are more likely to reach State HV than to reach State CH after an infinite number of Gospel encounters. This table also indicates that more than 1000 Gospel encounters are needed for U2s to have a better chance to reach State HV than to reach State CH. This observation suggests that the probabilities in the assumed one-step transition matrix of Example 7 may be unrealistically pessimistic, at least for U2s who by definition are considered to be "receptive" to the Gospel. Additional research could be conducted to find better estimates for the one-step transition probabilities for the model based on the Rainer scale. One could also investigate how to best represent greater evangelistic intensity in the more extensive model.

The present model highlights that, when it comes to personal evangelism, time is of the essence. Far too many of the people who God loves and who He would like to see come to repentance and faith (1 Timothy 2:4) are simply not going to do so (Matthew 7:13-14). For those who reject the Gospel, God will honor their choice (Luke 13: 3, 5). However, there will be some lost persons who have not heard the Gospel message communicated clearly or who need to hear it again before it is too late. The simulation results show, under the assumptions made in Examples 3 and 4, that over 1 out of every 8 lost persons would reach State CH within about 10 years. Precious time is being squandered (John 4:35); delayed obedience by Christians is simply disobedience.

It has been assumed here that $p_{RG,L} = 0$. The need for more intensive and sustained personal evangelism is even more critical if $p_{RG,L} \neq 0$, that is, if it is possible for a person who has been regenerated to lose or renounce his or her salvation.

Many Christians are at risk for being found with blood on their hands (Ezekiel 33:1-9) because they have not faithfully shared the Gospel with family members, friends, neighbors, coworkers, and casual acquaintances. Alternatively, great eternal rewards await those who lead others to faith in Christ (Daniel 12:3). A major change in emphasis on personal evangelism is essential; a moderate change will only have a modest impact on the proportion of persons who are ultimately saved. McRaney calls for "passionate obedience" to the Great Commission by Christians.[31] Kennedy says that sharing the Gospel should be the Christian way of life.[32] The simulation results provide quantitative support for their suggestions.

The need for greater personal evangelism cannot and should

not be met exclusively by pastors and their staffs. However, pastors must lead the way in personal evangelism in their churches.[33] Unchurched persons would prefer to learn about matters of faith from lay people, rather than from vocational ministers.[34] So, the most effective changes in personal evangelism must involve bold participation by lay people.

The words of the Apostle Peter have never been more appropriate: Sanctify Christ as Lord in your hearts, **always** being ready to make a defense to everyone who asks you to give an account for the hope that is in you, yet with gentleness and reverence (1 Peter 3:15, NASB, emphasis added). To make a truly significant difference in the eternal destinies of human beings, intentional personal evangelism efforts (2 Timothy 4:1-2) must become standard for Christians. The Gospel has supernatural power (Romans 1:16, Hebrews 4:12), provided Christians obediently tap into that power.

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Table 1. Evangelism Simulation Results for Example 3

Months (k)	$p_{L,CH}^{(k)}$	$p_{L,HV}^{(k)}$	$p_{L,CH}^{(k)} / p_{L,HV}^{(k)}$	$p_{L,L}^{(k)}$
1	0.00125	0	undefined	0.99825
2	0.00250	<0.00001	3996.50	0.99650
3	0.00374	<0.00001	1998.50	0.99476
4	0.00499	<0.00001	1332.50	0.99302
5	0.00623	0.00001	999.50	0.99128
6	0.00747	0.00001	799.70	0.98955
7	0.00870	0.00001	666.50	0.98781
8	0.00994	0.00002	571.36	0.98609
9	0.01117	0.00002	500.00	0.98436
10	0.01240	0.00003	444.50	0.98264
11	0.01363	0.00003	400.10	0.98092
12	0.01486	0.00004	363.78	0.97920
24	0.02940	0.00017	174.25	0.95883
36	0.04365	0.00038	114.68	0.93889
48	0.05760	0.00067	85.53	0.91936
60	0.07126	0.00104	68.25	0.90024
84	0.09773	0.00201	48.67	0.86318
108	0.12311	0.00325	37.88	0.82765
132	0.14744	0.00475	31.04	0.79358
156	0.17078	0.00649	26.32	0.76091
180	0.19315	0.00844	22.87	0.72959
216	0.22500	0.01175	19.15	0.68500
252	0.25490	0.01546	16.49	0.64314
288	0.28297	0.01951	14.50	0.60384
324	0.30933	0.02387	12.96	0.56694
360	0.33407	0.02848	11.73	0.53230
408	0.36473	0.03496	10.43	0.48938
456	0.39292	0.04176	9.41	0.44991
504	0.41883	0.04879	8.59	0.41363
552	0.44266	0.05598	7.91	0.38028
600	0.46456	0.06330	7.34	0.34962
720	0.51190	0.08176	6.26	0.28334
840	0.55026	0.10003	5.50	0.22963
960	0.58136	0.11767	4.94	0.18610
1080	0.60656	0.13442	4.51	0.15082
1200	0.62698	0.15010	4.18	0.12223
∞	0.71429	0.28571	2.50	0

Table 2. Evangelism Simulation Results for Example 4

Months (k)	$p_{L,CH}^{(k)}$	$p_{L,HV}^{(k)}$	$p_{L,CH}^{(k)} / p_{L,HV}^{(k)}$	$p_{L,L}^{(k)}$
1	0.00125	0	undefined	0.99747
2	0.00250	<0.00001	1558.03	0.99494
3	0.00374	<0.00001	779.01	0.99242
4	0.00498	0.00001	519.34	0.98991
5	0.00622	0.00002	389.50	0.98740
6	0.00745	0.00002	311.60	0.98490
7	0.00868	0.00003	259.67	0.98241
8	0.00991	0.00004	222.57	0.97992
9	0.01114	0.00006	194.75	0.97744
10	0.01236	0.00007	173.11	0.97497
11	0.01358	0.00009	155.80	0.97250
12	0.01479	0.00010	141.63	0.97003
24	0.02914	0.00043	67.74	0.94097
36	0.04306	0.00097	44.51	0.91277
48	0.05656	0.00171	33.15	0.88542
60	0.06966	0.00264	26.41	0.85889
84	0.09469	0.00504	18.78	0.80819
108	0.11825	0.00811	14.58	0.76048
132	0.14041	0.01179	11.91	0.71559
156	0.16126	0.01600	10.08	0.67334
180	0.18088	0.02071	8.73	0.63359
216	0.20817	0.02858	7.28	0.57833
252	0.23307	0.03728	6.25	0.52788
288	0.25580	0.04668	5.48	0.48183
324	0.27655	0.05664	4.88	0.43980
360	0.29549	0.06706	4.41	0.40144
408	0.31820	0.08150	3.90	0.35544
456	0.33830	0.09637	3.51	0.31472
504	0.35611	0.11151	3.19	0.27866
552	0.37187	0.12677	2.93	0.24673
600	0.38582	0.14203	2.72	0.21846
720	0.41411	0.17955	2.31	0.16115
840	0.43498	0.21531	2.02	0.11888
960	0.45038	0.24866	1.81	0.08770
1080	0.46173	0.27925	1.65	0.06469
1200	0.47011	0.30697	1.53	0.04772
∞	0.49367	0.50633	0.975	0

Table 3. Simulation Results for Moderately More Intense Evangelistic Efforts (Example 5)

	$p_{L,CH}^{(k)}$				
Months (k)	$\alpha = 0$	$\alpha = 0.01$	$\alpha = 0.05$	$\alpha = 0.25$	$\alpha = 0.50$
1	0.00125	0.00125	0.00125	0.00125	0.00125
2	0.00250	0.00250	0.00250	0.00250	0.00250
3	0.00374	0.00374	0.00374	0.00374	0.00374
4	0.00499	0.00499	0.00499	0.00499	0.00499
5	0.00623	0.00623	0.00623	0.00623	0.00623
6	0.00747	0.00747	0.00747	0.00746	0.00746
7	0.00870	0.00870	0.00870	0.00870	0.00870
8	0.00994	0.00994	0.00994	0.00993	0.00993
9	0.01117	0.01117	0.01117	0.01117	0.01116
10	0.01240	0.01240	0.01240	0.01240	0.01239
11	0.01363	0.01363	0.01363	0.01362	0.01361
12	0.01486	0.01486	0.01485	0.01485	0.01484
24	0.02940	0.02940	0.02940	0.02936	0.02932
36	0.04365	0.04365	0.04363	0.04355	0.04346
48	0.05760	0.05759	0.05756	0.05743	0.05726
60	0.07126	0.07125	0.07120	0.07100	0.07074
120	0.13540	0.13536	0.13521	0.13443	0.13348
180	0.19315	0.19307	0.19274	0.19112	0.18911
240	0.24514	0.24500	0.24446	0.24176	0.23845
300	0.29194	0.29174	0.29095	0.28701	0.28220
600	0.46456	0.46398	0.46169	0.45046	0.43698
900	0.56663	0.56567	0.56189	0.54354	0.52187
1200	0.62698	0.62571	0.62070	0.59655	0.56844
∞	0.71429	0.71225	0.70423	0.66667	0.62500

Table 4. Finality Measures Under Moderately More Intense Evangelistic Efforts (Example 5)

	$p_{L,L}^{(k)}$				
Months (k)	$\alpha = 0$	$\alpha = 0.01$	$\alpha = 0.05$	$\alpha = 0.25$	$\alpha = 0.50$
1	0.99825	0.99825	0.99823	0.99813	0.99800
2	0.99650	0.99649	0.99645	0.99625	0.99600
3	0.99476	0.99474	0.99468	0.99439	0.99401
4	0.99302	0.99300	0.99292	0.99252	0.99202
5	0.99128	0.99126	0.99116	0.99066	0.99004
6	0.98955	0.98952	0.98940	0.98880	0.98806
7	0.98781	0.98778	0.98764	0.98695	0.98608
8	0.98609	0.98605	0.98589	0.98510	0.98411
9	0.98436	0.98432	0.98414	0.98325	0.98214
10	0.98264	0.98259	0.98239	0.98141	0.98018
11	0.98092	0.98086	0.98065	0.97957	0.97822
12	0.97920	0.97914	0.97891	0.97773	0.97626
24	0.95383	0.95872	0.95826	0.95596	0.95309
36	0.93889	0.93872	0.93805	0.93467	0.93046
48	0.91936	0.91914	0.91826	0.91385	0.90838
60	0.90024	0.89997	0.89889	0.89350	0.88681
120	0.81044	0.80995	0.80800	0.79835	0.78644
180	0.72959	0.72893	0.72631	0.71333	0.69742
240	0.65681	0.65602	0.65287	0.63736	0.61849
300	0.59128	0.59040	0.58686	0.56948	0.54848
600	0.34962	0.34857	0.34440	0.32431	0.30083
900	0.20672	0.20579	0.20211	0.18469	0.16500
1200	0.12223	0.12150	0.11861	0.10518	0.09050
∞	0	0	0	0	0

Table 5. Simulation Results for Aggressively More Intense Evangelistic Efforts (Example 6)

	$p_{L,CH}^{(k)}$				
Months (k)	$\alpha = 1$	$\alpha = 3$	$\alpha = 5$	$\alpha = 9$	$\alpha = 19$
1	0.00125	0.00125	0.00125	0.00125	0.00125
2	0.00250	0.00250	0.00249	0.00249	0.00249
3	0.00374	0.00374	0.00373	0.00373	0.00371
4	0.00498	0.00498	0.00497	0.00495	0.00492
5	0.00622	0.00621	0.00620	0.00617	0.00611
6	0.00746	0.00744	0.00742	0.00738	0.00729
7	0.00869	0.00867	0.00864	0.00859	0.00846
8	0.00992	0.00989	0.00985	0.00978	0.00961
9	0.01115	0.01110	0.01106	0.01097	0.01076
10	0.01237	0.01232	0.01226	0.01215	0.01189
11	0.01360	0.01353	0.01346	0.01333	0.01300
12	0.01482	0.01473	0.01465	0.01449	0.01411
24	0.02924	0.02891	0.02858	0.02794	0.02642
36	0.04329	0.04253	0.04181	0.04041	0.03717
48	0.05693	0.05564	0.05438	0.05198	0.04656
60	0.07023	0.06824	0.06632	0.06270	0.05475
120	0.13158	0.12437	0.11769	0.10575	0.08253
180	0.18518	0.17055	0.15748	0.13530	0.09661
240	0.23200	0.20853	0.18829	0.15558	0.10376
300	0.27291	0.23977	0.21216	0.16951	0.10738
600	0.41175	0.33007	0.27128	0.19535	0.11099
900	0.48239	0.36407	0.28775	0.19929	0.11111
1200	0.51833	0.37688	0.29234	0.19989	0.11111
∞	0.55556	0.38462	0.29412	0.20000	0.11111

Table 6. Finality Measures Under Aggressively More Intense Evangelistic Efforts (Example 6)

	$p_{L,L}^{(k)}$				
Months (k)	$\alpha = 1$	$\alpha = 3$	$\alpha = 5$	$\alpha = 9$	$\alpha = 19$
1	0.99775	0.99675	0.99575	0.99375	0.98875
2	0.99551	0.99351	0.99152	0.98754	0.97763
3	0.99327	0.99028	0.98730	0.98137	0.96663
4	0.99103	0.98706	0.98311	0.97523	0.95575
5	0.98880	0.98386	0.97893	0.96914	0.94500
6	0.98658	0.98066	0.97477	0.96308	0.93437
7	0.98436	0.97747	0.97063	0.95706	0.92386
8	0.98214	0.97429	0.96650	0.95108	0.91347
9	0.97993	0.97113	0.96239	0.94514	0.90319
10	0.97773	0.96797	0.95830	0.93923	0.89303
11	0.97553	0.96483	0.95423	0.93336	0.88298
12	0.97333	0.96169	0.95018	0.92753	0.87305
24	0.94737	0.92485	0.90283	0.86030	0.76221
36	0.92211	0.88942	0.85785	0.79795	0.66545
48	0.89752	0.85534	0.81511	0.74012	0.58097
60	0.87358	0.82257	0.77450	0.68648	0.50721
120	0.76315	0.67663	0.59984	0.47126	0.25726
180	0.66667	0.55658	0.46458	0.32351	0.13049
240	0.58239	0.45782	0.35981	0.22208	0.06618
300	0.50877	0.37659	0.27867	0.15246	0.03357
600	0.25885	0.14182	0.07766	0.02324	0.00113
900	0.13169	0.05341	0.02164	0.00354	0.00004
1200	0.06700	0.02011	0.00603	0.00054	<0.00001
∞	0	0	0	0	0

Table 7. Distribution of 160 Million Simulated Unchurched Persons (Example 7)

Gospel Encounters (ℓ)	Persons (in Millions)							
	U5	U4	U3	U2	U1	RG	CH	HV
0	8.00	33.60	57.60	43.20	17.60	0	0	0
1	7.67	33.18	57.83	40.67	14.24	4.62	1.80	0
2	7.36	32.75	57.99	38.30	11.67	8.37	3.56	<0.01
3	7.06	32.32	58.08	36.07	9.69	11.47	5.29	0.01
4	6.78	31.90	58.11	33.98	8.16	14.07	6.98	0.02
5	6.51	31.47	58.09	32.02	6.97	16.26	8.65	0.04
6	6.25	31.04	58.01	30.18	6.03	18.15	10.29	0.05
7	6.01	30.61	57.89	28.45	5.28	19.79	11.90	0.07
8	5.78	30.18	57.73	26.83	4.68	21.23	13.48	0.09
9	5.56	29.76	57.53	25.30	4.19	22.51	15.04	0.11
10	5.35	29.33	57.29	23.88	3.79	23.66	16.57	0.14
12	4.96	28.49	56.72	21.28	3.17	25.66	19.55	0.18
14	4.60	27.66	56.04	19.00	2.71	27.33	22.43	0.24
16	4.28	26.84	55.26	16.99	2.36	28.77	25.21	0.29
18	3.99	26.03	54.41	15.22	2.08	30.02	27.90	0.35
20	3.72	25.24	53.50	13.65	1.85	31.12	30.50	0.41
25	3.15	23.35	51.04	10.51	1.41	33.34	36.64	0.57
30	2.69	21.56	48.41	8.20	1.10	35.01	42.29	0.74
35	2.32	19.90	45.72	6.50	0.88	36.28	47.49	0.92
40	2.01	18.35	43.04	5.23	0.71	37.25	52.29	1.10
45	1.76	16.92	40.43	4.29	0.58	38.01	56.72	1.29
50	1.56	15.59	37.90	3.57	0.49	38.59	60.81	1.48
60	1.24	13.24	33.18	2.60	0.36	39.42	68.09	1.87
70	1.00	11.25	28.95	1.99	0.28	39.94	74.31	2.27
80	0.83	9.57	25.00	1.60	0.22	40.26	79.64	2.67
90	0.69	8.15	21.92	1.32	0.19	40.45	84.22	3.07
100	0.58	6.94	19.04	1.11	0.16	40.53	88.16	3.48
200	0.12	1.49	4.61	0.25	0.04	38.86	107.16	7.47
300	0.03	0.34	1.11	0.06	0.01	35.67	111.57	11.21
400	0.01	0.08	0.27	0.01	<0.01	32.40	112.62	14.61
500	<0.01	0.02	0.06	<0.01	<0.01	29.35	112.87	17.70
1000	<0.01	<0.01	<0.01	<0.01	<0.01	17.80	112.95	29.25
∞	0	0	0	0	0	0	112.95	47.05

Table 8. Hell-to-Heaven Odds Ratios for Unchurched Persons Over Simulated Gospel Encounters (Example 7)

Gospel Encounters (ℓ)	Hell-to-Heaven Odds Ratios ($p^{(\ell)}_{L,CH} / p^{(\ell)}_{L,HV}$)				
	U5	U4	U3	U2	U1
1	undefined	undefined	undefined	undefined	undefined
2	undefined	undefined	undefined	1237	7.05
3	undefined	23547830	216497	456	3.42
4	6281921682	5929408	74488	252	2.22
5	1562079368	2438428	38387	167	1.63
6	621903229	1264646	23707	122	1.27
7	309681414	752741	16248	95.4	1.04
8	176335153	491029	11918	78.1	0.883
9	109875282	341947	9170	66.1	0.763
10	73061973	250078	7310	57.4	0.672
12	37050683	148761	5013	45.6	0.544
14	21323825	97825	3693	38.2	0.458
16	13388441	68980	2858	33.1	0.398
18	8958521	51195	2295	29.4	0.353
20	6293116	39506	1894	26.6	0.319
25	3032138	23330	1278	22.0	0.261
30	1698067	15491	939	19.1	0.224
35	1052322	11106	729	17.2	0.199
40	701561	8402	590	15.7	0.181
45	494294	6613	491	14.6	0.167
50	363682	5365	418	13.7	0.155
60	217256	3774	319	12.3	0.138
70	143022	2830	256	11.2	0.125
80	101031	2220	212	10.4	0.115
90	75274	1801	180	9.63	0.107
100	58455	1499	156	9.01	0.0994
200	14382	494	63.9	5.41	0.0606
300	7732	284	39.3	3.82	0.0437
400	5362	202	28.5	2.97	0.0346
500	4185	160	22.8	2.46	0.0290
1000	2293	89.5	12.9	1.49	0.0180
∞	1352	53.3	7.71	0.928	0.0113

Table 9. Spiritual Condition Finality Measures of Simulated Unchurched Persons (Example 7)

Gospel Encounters (ℓ)	Spiritual Condition Finality Measures				
	$p_{U5}^{(\ell)}$	$p_{U4}^{(\ell)}$	$p_{U3}^{(\ell)}$	$p_{U2}^{(\ell)}$	$p_{U1}^{(\ell)}$
1	0.95000	0.98000	0.99000	0.99200	0.74902
2	0.90253	0.96038	0.97994	0.97788	0.56173
3	0.85747	0.94112	0.96984	0.95962	0.42198
4	0.81468	0.92222	0.95971	0.93866	0.31769
5	0.77406	0.90368	0.94958	0.91607	0.23983
6	0.73550	0.88549	0.93944	0.89261	0.18170
7	0.69889	0.86764	0.92931	0.86883	0.13827
8	0.66412	0.85013	0.91920	0.84513	0.10582
9	0.63112	0.83295	0.90912	0.82176	0.08155
10	0.59978	0.81609	0.89907	0.79892	0.06339
12	0.54177	0.78335	0.87908	0.75526	0.03958
14	0.48947	0.75186	0.85927	0.71465	0.02615
16	0.44231	0.72158	0.83968	0.67717	0.01850
18	0.39978	0.69248	0.82032	0.64270	0.01408
20	0.36143	0.66452	0.80123	0.61104	0.01147
25	0.28120	0.59934	0.75473	0.54256	0.00808
30	0.21918	0.54048	0.71013	0.48646	0.00728
35	0.17121	0.48738	0.66754	0.43977	0.00656
40	0.13405	0.43952	0.62699	0.40026	0.00601
45	0.10526	0.39641	0.58850	0.36629	0.00554
50	0.08291	0.35760	0.55204	0.33664	0.00513
60	0.05202	0.29125	0.48500	0.28704	0.00442
70	0.03323	0.23755	0.42538	0.24676	0.00383
80	0.02170	0.19409	0.37257	0.21316	0.00333
90	0.01454	0.15888	0.32594	0.18463	0.00289
100	0.01003	0.13034	0.28487	0.16016	0.00252
200	0.00091	0.02044	0.07160	0.03899	0.00062
300	0.00018	0.00394	0.01746	0.00942	0.00015
400	0.00004	0.00086	0.00422	0.00226	0.00004
500	0.00001	0.00020	0.00101	0.00054	0.00001
1000	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
∞	0	0	0	0	0

NOTES

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